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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/635,507	08/09/2000	Krishnaswamy Ramkumar	CYPR-PM00005	5685

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EXAMINER
ANDERSON, MATTHEW A

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 09/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/635,507	RAMKUMAR ET AL.	
	Examiner	Art Unit	
	Matthew A. Anderson	1765	

-- The MAILING DATE of this c mmunication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 June 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *29-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) *36-45* is/are allowed.

6)☒ Claim(s) *29-35 and 46-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 August 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 29-30, 32-34, 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thei et al. (US 6,350,662 B1) in view of Wolf et al. (Silicon Processing for the VLSI Era Volume 1: Process Technology, Lattice Press, Sunset Beach, CA USA, pp. 218-219, 228, 1986.

Thei et al. discloses a method to reduce defects in shallow trench isolations by post liner anneal. The substrate has reduced defects by a nitrogen anneal. A silicon substrate is provided. Etching is used (RIE which stands for reactive ion etching) on the substrate to form the shallow trenches with corners seen in Fig. 4. A liner silicon oxide layer (LINOX of the applicant's claims) is grown by wet oxidation at between about 800-900 degrees C or by dry oxidation at from about 900-950'C on the interior surfaces of the shallow trenches. The substrate and liner are annealed to reduce or eliminate defects, dislocations, interface traps, and stress in the silicon substrate. This inherently must mean that the stress in the liner oxide are also reduced since the liner is formed

on the substrate. The anneal takes place in N_2 at a temperature of between about 1000 to 1150 degrees C. (see col. 4 lines 1-10) A silicon oxide isolation layer is then (i.e. subsequently) deposited (i.e. backfilled) by high density plasma low pressure CVD (see col. 4 lines 20-30) over the liner layer and completely filling the shallow trenches. (see abstract for the above). Then, as in col. 4 lines 44-55, after planarization by CMP, polysilicon features are deposited and defined (i.e. etched) by processing steps typical in the art over the isolation structure thus formed. Thei et al. discloses the anneal as a way of reducing defects and breakdown of the isolation. The leakage in a semiconductor device is an inherent result of the breakdown of the oxide isolation. (see col. 1 and 2 lines 60+ and 1-20, respectively) RIE was known to be inherently a plasma process for etching trenches. (see Akatsu et al. US 6,319,794 B1 col. 6 lines 54-60.)

Thei et al. does not specify lowering the temperature after the nitrogen anneal.

Wolf et al. discloses low temperature techniques for forming SiO_2 by CVD page 219. Also, at processing temperatures less than 800'C, stress at corners of SiO_2 is not large enough to cause plastic deformation (i.e. defect formation).

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the references and perform the method of claim 29 because Thei et al. gives a process for the formation of shallow trench isolation structures with reduced defects and stress and Wolf et al. suggests using a low temperature method of SiO_2 plasma CVD to fill the trench so as to avoid high process

temperatures and possible formation of defects in the fill step. Motivation is the avoidance and prevention of defects.

In respect to claims 30, 32, 34, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the oxidation and anneal temperature as well as the length of annealing of the liner oxide layer because Thei et al. suggests a temperature of about 900-950'C for oxidation followed by 1000-1150'C anneal for about 30 to 150 minutes, Thei establishes time and temperature as result effective parameters, and such optimization would have been achieved with only routine experimentation. The anneal was described as repairing any damage done and to reduce stress added to the substrate during the RIE and liner oxide growth step in Col. 4 lines 11-15 and performing this step until the results were achieved was thus obvious.

In respect to claim 33, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use nitrogen as the anneal gas because this is suggested by Thei et al.

In respect to claim 46, it would have been obvious to one of ordinary skill in the art at the time of the present invention to cool down to the substrate in a shallow trench isolation process directly from the anneal to the trench fill deposition temperature because such would speed processing and avoid additional thermal cycling stress.

3. Claims 31, 35, 47, 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Thei et al. and Wolf et al., as applied to the above claims in further view of Olsen et al. (US 6,150,234).

Thei et al and Wolf et al. combined are described above.

Thei et al. combined do not explicitly state that the first gaseous environment contain oxygen and chlorine.

Olsen et al. discloses that an oxidation gas of O_2 and chlorine form the liner layer in a shallow trench isolation process. HCl or $C_2H_2Cl_2$ are given as the chlorine supplying gases used. Temperature of 1075'C is used in the oxidation step. The chlorine is disclosed as rounding corners which helps to reduce the device failure rate. (see col. 2 lines 15-20.) Inert gas such as N_2 and Ar can be added to the gas mix and thus slow the oxidation which in turn causes rounding at the corners. (Col. 3 lines 30-45.)

In respect to claim 31 and 48, it would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the knowledge of Thei and Wolf with that of Olsen et al. because Olsen et al. add corner rounding to improve the isolation structure achieved. Motivation is given in that the device would then be expected to overcome failure and reliability issues (col. 2 lines 15-20.)

In respect to claim 35 and 47, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature of the isolation fill step because Wolf et al. discloses 800'C as a point at which stress reaches a critical level, desire to not undo the previous anneal step to reduce stress in the substrate, and because such optimization would have been achieved with only routine experimentation.

Response to Arguments

4. Applicant's arguments filed 6/23/2003 have been fully considered but they are not persuasive.

The argument that no motivation to combine was properly given is not persuasive. The examiner notes that motivation for the combination was provided previously and exist in the record regardless of whether or not the applicant agrees with that motivation.

The argument that the motivation is faulty since Wolf says the lower temperature growth methods give inferior properties and require thermal annealing is not persuasive. First, the argument proves the obviousness of the need to anneal the low temperature liner oxide. Wolf et al. suggests that defects caused by stress at the corners can be avoided if the temperature is controlled during processing (page 228). Wolf et al. does not say the CVD or PVD grown SiO_2 is defective, merely that it is of less quality than thermally grown SiO_2 and does not state that they require an anneal process. Thei et al. discloses that sufficient isolation oxide can be grown with a plasma process, regardless.

Allowable Subject Matter

5. Claims 36-45 are allowed.

6. The following is an examiner's statement of reasons for allowance:

Thei et al. nor Olsen et al. do not suggest the use of the three step ramp up liner oxide deposition/anneal followed by a temperature decrease/shallow trench isolation fill with different gas chemistries at the different steps.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (703) 305-2667. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA
September 9, 2003

NADINE G. NORTON
PRIMARY EXAMINER